

## **IN THE CLAIMS:**

This listing of claims will replace all prior versions, and listing, of claims in the application.

### **Listing of the Claims:**

1. (Currently amended) A method of separating a plurality of source signals from a composite signal (104) expressed as a series of values of signal amplitude, each source signal having a respective period similar or equal to  $p$ , ~~characterised in that the method incorporates~~ comprising the steps of:
  - (a) expressing the composite signal (104) as a matrix  $X$  having rows each of which is a respective segment of signal amplitude values and corresponds to a length of time associated with a signal cycle;
  - (b) implementing a decomposition of the matrix  $X$  by decorrelation and normalisation to obtain decomposition results; and
  - (c) performing independent component analysis (ICA) of the decomposition results to obtain at least one of estimated separated signal modulation envelopes and estimated separated signal cyclelets.
2. (Currently amended) A method according to Claim 1 ~~characterised in that it includes~~ including the step of estimating source signal period  $p$  by synchronous averaging of the composite signal (104).
3. (Currently amended) A method according to Claim 1 ~~characterised in that~~ wherein the decomposition is a singular value decomposition generating decomposition results comprising two singular vector matrices and a singular value matrix, and the step of performing ICA is carried out using one of the singular vector matrices to obtain at least one of an independent component matrix and an associated component matrix one of which matrices contains estimated separated signal modulation envelopes and the other contains estimated separated cyclelets.
4. (Currently amended) A method according to Claim 3 ~~characterised in that it includes~~

including the step of determining the ~~determination~~ of source signal period by trialling a number of possible periods  $p'$ , and wherein steps (a) and (b) are carried out for each possible period  $p'$  to derive and decompose a respective matrix  $X_{\text{test}}$ , each matrix  $X_{\text{test}}$  has a probability associated with its decomposition results, and step (c) is carried out with decomposition results of that matrix  $X_{\text{test}}$  having maximum probability and taken to be the matrix  $X$  associated with the period  $p$  subject to this period not corresponding to a multiple of a true period.

5. (Currently amended) A method according to Claim 3 ~~characterised in that~~ wherein the signal modulation envelopes are more statistically independent than the cyclelets and step (c) is performed on a singular vector matrix  $U$  to obtain an independent component matrix  $UR_2^T$  containing estimated separated signal envelopes and a matrix  $R_2\lambda V$  containing estimated separated cyclelets.
6. (Currently amended) A method according to Claim 3 ~~characterised in that~~ wherein the cyclelets are more statistically independent than the signal envelopes and step (c) is performed on a singular vector matrix  $V$  to obtain an independent component matrix  $R_1^TV$  containing estimated separated cyclelets and a matrix  $U\lambda R_1$  containing estimated separated signal envelopes.
7. (Currently amended) A method according to Claim 1 ~~characterised in that it includes~~ including an additional step of estimating a number  $q$  of source signals with periodicities similar or equal to  $p$  present within the composite signal (104) and reducing the decomposition results in accordance with such number prior to performing step (c).
8. (Currently amended) A method according to Claim 7 ~~characterised in that~~ wherein the number  $q$  of source signals is estimated from the source signals' origins.
9. (Currently amended) A method according to Claim 7 ~~characterised in that~~ wherein the number  $q$  of source signals is estimated from a number of elements of a singular value matrix  $\lambda$ , the elements having values exceeding a threshold value.

10. (Currently amended) A method according to Claim 1 ~~characterised in that~~ wherein the composite signal (104) is detected by a single sensor (12).
11. (Currently amended) A method according to Claim 1 ~~characterised in that~~ including detecting the source signals ~~are detected by using~~ a plurality of sensors (174, 176) each of which provides a respective composite signal (104) from which a respective matrix  $X$  is obtained and analysed in steps (a) to (c).
12. (Currently amended) A method according to Claim 1 ~~characterised in that~~ including detecting the source signals ~~are detected by using~~ a plurality of sensors (174, 176) providing respective composite signals, and the matrix  $X$  is obtained from the composite signals collectively.
13. (Currently amended) A method according to Claim 1 ~~characterised in that it is a method~~ for apparatus condition monitoring, the source signals being obtained with the aid of at least one sensor (12) from a plurality of apparatus sources, and the at least one of estimated separated signal modulation envelopes and estimated separated signal cyclelets being analysed for indications as to the condition of respective apparatus sources.
14. (Currently amended) Computer apparatus (150) for separating a plurality of source signals from a composite signal (104) expressed as a series of values of signal amplitude, the source signals having periodicities similar or equal to  $p$ , the computer ~~characterised in that the computer apparatus is being~~ programmed to:
  - (a) express the composite signal (104) as a matrix  $X$  having rows each of which is a respective segment of signal amplitude values and corresponding to a length of time associated with a signal cyclelet;
  - (b) decompose the matrix  $X$  by decorrelation and normalisation to obtain decomposition results; and
  - (c) perform independent component analysis (ICA) of the decomposition results to obtain at least one of estimated separated signal modulation envelopes and estimated separated signal cyclelets.

15. (Currently amended) Computer apparatus ~~(150) arranged to separate~~ for separating a plurality of source signals from a composite signal expressed as a series of values of signal amplitude, the source signals having periodicities similar or equal to  $p$ , ~~characterised in that~~ and the computer apparatus ~~(150) is being~~ programmed to:
- (a) partition the composite signal into a plurality of partition matrices  $X$  having rows each of which is a respective segment of signal amplitude values and corresponds to a length of time associated with a signal cycle;
  - (b) perform a singular value decomposition (SVD) of at least one of the matrices  $X$  to obtain two singular vector matrices  $U$ ,  $V$  and a singular value matrix  $\lambda$ ;
  - (c) estimate a true period  $p$  of the source signals from an average of data within rows of the partition matrices  $X$ ; and
  - (d) perform an independent component analysis of one of the singular vector matrices  $U$ ,  $V$  generated by SVD from the matrix  $X$  partitioned in accordance with the estimated period  $p$  and so to obtain an independent component matrix  $UR_2^T$ ,  $R_1^TV$  and an associated component matrix  $R_2\lambda V$ ,  $U\lambda R_1$ , ~~characterised in that~~ one component matrix  $UR_2^T$ ,  $U\lambda R_1$  ~~contains~~ containing estimated separated signal modulation envelopes and the other  $R_2\lambda V$ ,  $R_1^TV$  ~~contains~~ containing estimated separated cycles.
16. (Currently amended) A computer-readable medium embodying instructions for execution by computer ~~processor~~ apparatus, the instructions relating to separation of a plurality of source signals from a composite signal ~~(104)~~ expressed as a series of values of signal amplitude, the source signals having periodicities similar or equal to  $p$ , ~~characterised in that~~ and the computer-readable medium ~~incorporates~~ incorporating program code for controlling a computer ~~processor~~ apparatus to:
- (a) express the composite signal ~~(104)~~ as a matrix  $X$  having rows each of which is a respective segment of signal amplitude values and corresponds to a length of time associated with a signal cycle;
  - (b) decompose the matrix  $X$  by decorrelation and normalisation to obtain decomposition results; and
  - (c) perform ICA of the decomposition results to obtain at least one of estimated separated

signal modulation envelopes and estimated separated signal cyclets.

17. (Currently amended) A computer-readable medium embodying instructions for execution by ~~a processor~~ computer apparatus, the instructions relating to separation of a plurality of source signals from a composite signal (104) expressed as a series of values of signal amplitude, the source signals having periodicities similar or equal to  $p$ , ~~characterised in that~~ the computer-readable medium ~~incorporates~~ incorporating program code for controlling computer apparatus to:

- (a) ~~partitioning~~ the composite signal (104) into sections to provide respective rows of a partition matrix  $X$ ;
- (b) ~~performing~~ a singular value decomposition of the matrix  $X$  to obtain two singular vector matrices  $U$ ,  $V$  and a singular value matrix  $\lambda$ ; and
- (c) ~~performing~~ an independent component analysis of one of the singular vector matrices  $U$ ,  $V$  to obtain an independent component matrix  $UR_2^T$ ,  $R_1^TV$  and an associated component matrix  $R_2\lambda V$ ,  $U\lambda R_1$ , ~~characterised in that~~ one matrix  $UR_2^T$ ,  $U\lambda R_1$  ~~contains~~ containing estimated separated signal modulation envelopes and the other matrix  $R_2\lambda V$ ,  $R_1^TV$  containing estimated separated cyclets.